# METHOD AND INSTRUMENT FOR DETERMINING THE DISTORTION ANGLES IN TEXTILE FABRICS OR SIMILAR, WHETHER FIXED OR IN MOVEMENT



## Field of the invention

This invention concerns the detection and measurement of certain characteristics of textile fabrics, whether fixed or in movement, and, in particular, refers to a method and an instrument for determining the distortion angles of fabrics made on the loom, meshed or similar.

## State of the art

The normally right-angled structure between weft and warp, created by the fabric production machinery or similar can often be altered by the machines used for subsequent phases of the processing or treatment. A similar alteration also occurs when working meshed fabrics or similar.

This deformation of the fabric is normally identifiable by the formation of an oblique distortion angle or an arched distortion angle, shown as a1 and a2, respectively, in Fig. 1. In order to bring the distortions back within acceptable standardised limits, it is necessary to use automatic machines, normally defined as "aligners", which operate according to the measurement of said angles.

Since the fabric is checked in a certain, finite number of points, depending on the number of sensors installed, the determining of these angles is carried out by means of processing the sensor data using mathematical algorithms, such as the calculation of the average values of the local deformations or the analysis of the appropriate functions calculated for the values themselves.

The number of analysis points needed to give a reliable calculation of the deformations may be obtained by installing a sufficient number of sensors, or by a smaller number of sensors but where each is capable of analysing various points of the fabric by moving the sensor at right angles to the length of the fabric, as illustrated in Figs 2 and 3, respectively.

There are already various types of sensors on the market for measuring the distortion angles, made with photodiodes or other devices, which require mechanical parts that rotate or oscillate. There are also static sensors, made with CCD

(charge coupled device) linear detectors, connected in various ways in order to form images over time that appear as a succession of lines.

However, all these solutions function only if there is a relative movement between the fabric and the sensor, as described, for example, in patent EP 0 741 290. Furthermore, the linear structure requires the sensor to be mounted in a pre-set direction and the measurement solution is intrinsically different in the two right-angled directions.

Therefore, generally speaking, almost all the existing systems include the use of one or more light sources in continuous operation, which requires a certain attention to energy dissipation.

Purpose and description of the invention

One aim of this invention is to propose a sensor with photosensitive elements, using CCD or CMOS technology, in which there is no longer the need to carry out periodic maintenance on the mechanical parts, typical of the existing equipment, and which functions irrespectively of its orientation towards the fabric.

Another purpose of the invention is to provide a method of detecting the distortion angles and a sensor that will allow a real image of the fabric to be obtained, just as an operator would see it, with a constant measurement solution in every direction and accurate measurements, whether the fabric is

fixed or moving with respect to the sensor, without having recourse to synchronisation or other compensatory measures.

A further aim of the invention is to provide a detection method that requires just a brief light impulse, sufficient just to obtain the image, without additional waste of energy.

Yet another purpose of the invention is to propose a sensor that includes, in one single functional unit, besides the photosensitive device, all the electronic devices for storing and processing the image, the light source with its control devices, as well as the interfaces for transferring the measurements and dialoguing with the supervision and control system.

This invention is also intended for faller devices, or equipment with a similar construction for the correction of fabric deformation etc., which consists of at least one of the sensors according to the invention, held to the fixed or moving parts and, anyway, positioned with respect to the faller device itself.

Likewise, the invention can be profitably used for making checking machines and defect certification machines.

The compactness of the unit containing all the operational elements and the planning solutions adopted means that the product can be used even in environments subject to light or electromagnetic interference without having recourse to

optical transmission means for the image, such as fibre optics or other.

Said purposes and the consequent advantages are obtained by using a detection method for the distortion angles of a fabric or similar, fixed or in motion, according to at least claim 1, and with a sensor, according to at least claim 6.

Essentially, the method proposed for verifying the deformation of the textile fabrics or similar, is based on the use of one or more sensors which analyse contemporarily, or at pre-defined moments, one or more limited areas of the fabric, combined with a supervision and control system for the sensors, which elaborates the angles of oblique and arched deformation and sees to the automatic correction.

Compared to existing solutions, therefore, this invention supplies a method and an instrument for gathering the basic information necessary for determining the distortion angles of a textile fabric or similar. On receiving a command from the supervision and control system, each area of the fabric or similar to be explored is illuminated with a light source for just the time necessary to form an image, which is memorised inside the sensor, where it is also analysed by means of algorithms based on two-dimensional transformations such as FFT (Fast Fourier Transform), in order to determine the angle of difference to 90°.

Brief description of the drawings

Further details of the invention will become clear from the following description, made with reference to the enclosed drawings, which are indicative but not binding, and in which:

Fig. 1 shows a textile fabric on which the possible angles of oblique (a1) and arched (a2) distortion are shown;

Figs 2 and 3 show two different layouts of the detector sensors, according to the state of the art;

Fig. 4 shows a block diagram of the sensor according to the invention;

Fig. 5 shows a functional diagram of the acquisition, processing and communication block of the sensor;

Fig. 6 shows the flow diagram of the various detection phases of the distortion angles of the fabric, according to the method of the invention;

Fig. 7 shows an image of the fabric when fixed, or in movement, as it is recorded by the sensor and visualised on the user interface of the supervision and control system; and

Fig. 8 shows a two-dimensional frequency spectrum as it is elaborated by the sensor and visualised on the user interface of the supervision and control system.

Detailed description of the invention

A system for measuring the angles of local distortion a1 and/or a2 of a textile fabric 11 essentially requires at least

one detector sensor 12, a transmission system 13 for the signals or information acquired, and at least one unit for processing, supervision and control 14.

According to one preferred version of the invention, the angles of local distortion are processed directly inside the sensor itself and then transmitted to the supervision and control system for commanding the correction machines as necessary.

In fact, with reference to Fig. 4, the sensor that dialogues with the supervision and control system consists of the following functional groups:

- Optics for focussing on the area of the fabric to be explored;
- Impulse illuminator with solid state devices, preferably of the infra-red type;
- Illuminator control circuit for commanding the duration of illumination; and
- Integrated acquisition, processing and communication unit.

In particular, the integrated acquisition, processing and communication unit consists of the following devices (Fig. 5):

- Photosensitive device, CCD type or other technology, for example CMOS, in matrix;
- FIFO device for direct transfer to the central processing

unit of the digital image recorded by the photosensitive device;

- Central processing unit responsible for:
  - o commanding the impulse illumination system;
  - o acquiring data originating from the photosensitive device;
  - o carrying out all the processing to obtain the angle of local deformation;
  - o storing all the information obtained;
  - o transferring said information, by means of standard interfaces, to the supervision and control system according to a predefined protocol;
- FLASH memory in which there is installed the firmware which operates the unit and which stores all the data regarding the sensor functioning;
- RAM memory for dynamic storing of the service data;
- Ethernet interface, operating with the TCP-IP protocol;
- Serial interface half duplex RS 485;
- Any other interface of another type, for example, RS 422 or other.

The use of a photosensitive matrix device means that an asynchronous record can be made of the fabric image, for example, when requested by the supervision and control system. With such a matrix device, illumination of the area of fabric to be explored is reduced, in fact, to a brief impulse

which is just sufficient to obtain the image, corresponding, practically, to a photograph.

Furthermore, the asynchronous image acquisition makes it possible to analyse the distortion angles even of a fabric which is fixed or at an angle with respect to the sensor.

The supervision and control system is made with a structure based on Personal Computer which, apart from determining the values of the angles of oblique and arched deformation on the basis of the angles of local deformation provided by the sensors, also provides the functions of user interface and the control of any processing machines.

The procedure for determining the angles of local deformation consists of the following steps (Fig. 6):

- impulse illumination of an area of the fabric with a light source, preferably solid state with infra-red emission;
- acquisition, in digital form, of the real image of the area of fabric under study, irrespectively of the orientation of the optical detector with regard to the fabric, with illumination of the fabric itself for a period just long enough to acquire the image;
- treatment of the image, that is, compensation of the orientation of the axes of symmetry of the optical detector with respect to the fabric and application of the algorithms useful for increasing the reliability of the results of subsequent processing;

- data processing, that is, application of the two-dimensional Fourier transformation to the recorded image and determination of the angle of local deformation by means of analysis of the two-dimensional spectrum obtained;
- transmitting the value of the local distortion angle and messages about the operating state of the sensor to the supervision and control system.

An example of the digital image acquired by the sensor and visualised by the supervision and control system is illustrated in Figure 7, in which there can be seen the image as it would appear to the operator who was observing the area under study.

Applying the Fourier transformation to this image, we obtain the two-dimensional spectrum represented in Figure 8, as it could be acquired and visualised by the supervision and control system. The co-ordinates of these points constitute the basic data for determining the angle of local deformation.